A process model for developing learning design patterns with international scope

Lotz, N., Law, E.LC. & Nguyen-Ngoc, A.V. Education Tech Research Dev (2014) 62: 293. doi:10.1007/s11423-014-9333-x

DEVELOPMENT ARTICLE

A process model for developing learning design patterns with international scope

Nicole Lotz, Effie Lai-Chong Law & Anh Vu Nguyen-Ngoc

Abstract

This paper investigates the process of identifying design patterns in international collaborative learning environments. In this context, design patterns are referred to as structured descriptions of best practice with pre-defined sections such as problem, solution and consequences. We pay special attention to how the scope of a design pattern is identified and articulated. Based on a review of the seminal design patterns literature and current practice in the area of learning design, the lack of a more specific process description for developing patterns with international scope is identified. The paper suggests a process model for developing patterns with international scope. This model is exemplified in a case study that links the analysis of observation in international learning environments to the articulation of design patterns by identifying culturally independent core values that constitute the foundations of a design pattern with international scope. These core values are linked to recurrent learning behaviors and specific artifacts that support learning in the articulation of a design pattern. The findings contribute to gaining a deeper understanding of the pattern scoping and abstraction process in international learning environments.

Keywords: Pattern development, International scope, Learning design

1. Introduction

Designing is a complex activity and design problems are often ill defined (Rittel and Webber 1984). A holistic and synergetic approach is required to understand and solve design problems (Cross 2006). For this, designers rely on first principles, which are fundamental insights a designer has gained in the past (Cross 2006) and precedence, which are cognitive patterns that link problems to solutions (Lawson 2004). Unfortunately such insights are tacit, locked away in the designer's head, and difficult to make explicit and share with others. Learning design requires sharing of expertise and teamwork between system and service designers, content providers and software engineers.

Think about a learning design that aims at supporting international collaboration of learners. How do you find out if there is any precedence or good practice in designing an international collaborative learning environment? How do you know that your design satisfices the expectations and values of students across cultures? In such ill-defined and realistic design problem scenario, it is difficult to break down the design problem in all its subcomponents and then solve it rationally by analyzing and putting together the sub-solutions. In fact such a rational approach to designing was first propagated by the architect Christopher Alexander (1964) and then later rejected by the same scholar (Alexander 1971) who conclusively proposed the very different, more holistic design pattern approach in the late 1970s (Alexander et al. 1977; Alexander 1979). Alexander's goal was to establish a design language and to share knowledge about good design, similar to the more recent proposal in Learning Design by Gibbons et al. (2008).

Alexander, in collaboration with his international colleagues, had identified successful practical solutions for the building environment that capture the positive aspects of dwelling, which were thought to have a sustainable effect on human society and natural environment. Alexander claimed that they had identified design patterns across cultures and geographical

boundaries (Alexander 1979). For example, the pattern *Entrance Transition* describes a spatial entrance situation that supports the creation of a change in the human perception of the outside and inside of a house. The pattern description is supported by pictures of entrance situations in four different cultural contexts. The pictures are examples that illustrate the more abstract principle, which in conjunction suggests international scope of this solution (Alexander et al. 1977). We define international scope in design patterns as the extent to which a pattern observed in one cultural context can be applied to other cultural contexts.

A decade after the seminal work by Alexander, the pattern approach was developed and applied in different fields such as Software Engineering (Gamma et al. 1994), Human-Computer Interaction (Borchers 2001), and Technology-enhanced Learning (Fincher 1999; Avgeriou et al. 2003). The definition of a design pattern remains nearly unaltered from Alexander's original proposition. A pattern is a good solution to a recurring problem in a specific context or domain such as Learning Design. Learning Design patterns capture good solutions in the design of learning activities that are based on pedagogical principles and supported by technological and human resources.

Although many learning design pattern developments discuss and partly build on Alexander's work (i.e., Retalis 2006; Winters and Mor 2008; Dimitriadis 2009), they do not consider some important but elusive points Alexander has made about patterns and their relation to culture, i.e., in *Entrance Transition* the core shared value of boundaries between in-groups and out-groups is made explicit and exemplified internationally. Learning design patterns do not demonstrate international scope as Alexander's did. Learning design patterns do not make explicit whether or not the core values that are created by using a design pattern are acceptable or desirable across cultures. Thinking back to our scenario above, it is likely that our learning design team would want to look for good practice, such as design patterns, in designing international collaborative learning environments. An essential criterion for our

learning design team would be to know whether or not a design pattern could be used in this international collaborative learning context.

We argue that a lack of international scope is particularly problematic in learning design patterns, because social and learning activities do vary across cultures and cannot be assumed to be universal (Hofstede 1986; Kim and Bonk 2002; Rutkowski et al. 2002; Denman-Maier 2004; Walker and Creanor 2005; Vatrapu and Suthers 2007). Research in the area of internationalization of software rightly flagged up potential risks and difficulties in using the same software design (i.e., navigation or metaphors) to support learning activities across cultures (del Galdo and Nielsen 1996; Evers 2003; Rogers et al. 2007). However, looking at learning design patterns we cannot find any indication, implicitly or explicitly (such as pictures, example quotes, references in literature), whether or not these patterns have been observed in multiple cultural contexts and whether they can thus be re-applied across cultures. A detailed description of such patterns without international scope is given in the section 2 of this paper.

We experienced in our practice confusion about the essential steps of pattern development accompanied with difficulties in scoping patterns. Pattern development processes are not captured in a way that can be easily grasped by novices. The fuzziness, ambiguity and inconsistency in process lead to a lack of international scope in the patterns' structured description. First, there is no formalized process for pattern development[1], and second, the scope of a pattern is strongly rooted in the data from which the pattern is derived. If the data is collected and analyzed in only one cultural context and the pattern authors neither limit its scope nor seek feedback from an international community during the pattern development to articulate its international scope, the pattern cannot automatically assume

[1] Pattern development is a term used to describe a process of identifying and sharing best practice among scholars and practitioners.

international scope. In view of this gap in research and scholarly practice, we ask: *How can we develop learning design patterns with international scope?*

The main goal of the paper is to propose a process model for developing learning design patterns with international scope. We believe that a formalized and more specific model of pattern scoping[2] will improve international learning design practice.

In an overview, first we will demonstrate the lack of international scope in three exemplar learning design patterns. Then we will review the process of pattern development used for these patterns. From this review, we propose a formalized process model and identify how international scope can be incorporated into this model. This is tested and discussed in a case study of pattern development with international scope.

2. Learning design patterns without international scope

The scope of a pattern is captured within different sections of the pattern narrative. These sections commonly include: name, summary, context, problem, solution, consequences or examples and references. We discuss three different learning design patterns, namely[3] *Feedback Sandwich* (Eckstein et al. 2002; Bergin 2007), *Study Toolkit* (Avgeriou et al. 2003; Retalis 2005; Goodyear 2005), and *Soft Scaffolding* (Winters and Mor 2008; Mor and Winters 2008; Pachler et al. 2009). In summary, the pattern *Feedback Sandwich* suggests wrapping negative or challenging feedback in a positive or encouraging feedback frame, so that learners are not discouraged by the negative feedback. The pattern *Study Toolkit* suggests that learners should be able to manipulate a virtual learning environment directly, such as

[2] The term pattern scoping is a synonym for pattern development. However, it emphasises the combination of analytic (observing and understanding), descriptive and synergetic (constructing and using) processes in pattern development.

[3] The pattern authors usually choose inspiring and metaphoric names that are meant to motivate further reading of the pattern. These names are also used as memorable synonyms that signify the overall idea in design team discussions. For example, *Feedback Sandwich* suggests only by its name that a layer of different feedback (filling) is placed in a frame of one kind of feedback (bread).

through annotation of the content. Similarly *Soft Scaffolding* suggests that learners and teachers should be able to overrule automatic responses from an interface.

The general scope of a learning design pattern is framed first by a textual description of the context in which a pattern applies. For example, *Feedback Sandwich* can be applied when giving feedback to students (with or without technological support), *Study Toolkit* and *Soft Scaffolding* can be applied in designing user interactions with new Learning Management Systems (LMS), for example a Virtual Learning Environment or Wiki. Within this context the design problem is defined and forces are described. Forces are conflicting requirements that have to be resolved when dealing with the problem. While the problem and forces in *Feedback Sandwich* center around the challenges of alienating students when giving negative feedback only, *Study Toolkit* problematizes the lack of interaction with standard HTML pages and *Soft Scaffolding* discusses the linearity in studying online learning activities as a problem.

To solve the problem, *Feedback Sandwich* advocates offering positive feedback at the beginning and the end of a feedback session. A pattern usually also explains the underlying reasons and consequences of its use. It can be part of the solution section or a separate section. Sometimes this is replaced or supported by an example from practice or a theoretical justification. *Feedback Sandwich* justifies its solution by emphasizing its use in the pattern author community. The solution is grounded in the personal experience of the pattern writer (Australian) of how a particular pattern operates, but there is no explicit specification of its international scope. However, from the literature of international learning we learn about limitations of such indirect communication mechanisms in cultures that value more direct communication (Rutkowski et al. 2002). Students from these cultures might not perceive a negative comment as important if it is sandwiched between positive comments as in *Feedback Sandwich*.

Study Toolkit advocates that a LMS should offer students a toolkit to annotate learning materials. The authors advise "*... to put bookmarks on point of interest and/or make comments within the hypertext using either "free text" or specific notations, i.e., a specific symbol should mean "question mark", "criticism", etc*." The pattern authors give examples of LMS systems that use similar strategies to further define the scope of the pattern. Although at first sight this seems like a reasonable strategy, findings in the field of internationalization and localization of interactive systems indicate cultural differences in interpreting signs and symbols (del Galdo and Nielsen 1996; Evers 2003; Rogers et al. 2007). In addition, the annotation of learning materials might not be universally usable given that in some cultures the word or text of the teacher or a person higher in hierarchy is not to be criticized or questioned (Hoftsede 1986; Fendler and Winschiers-Theophilus 2010). This limitation might also be applied to the pattern *Soft Scaffolding*. The pattern suggests enabling students and instructors to override pre-programmed scaffolding interfaces in interactive learning environments. A scaffolding interface provides learners with automatic tips and hints when completing online activities. This solution might have many applications, but not in all cultures, especially where students always assume that the infallibility of a teacher's/a system's answers (Fendler and Winschiers-Theophilus 2010).

In summary, the discussed learning design patterns implicitly assume a certain international scope. They do not sufficiently specify and articulate the scope of a pattern in the process of generalizing recurrent observations, i.e., limit the scope to the cultural contexts observed. Based on our literature review and observations of the practice of pattern scoping processes, we concluded that this problem is rooted in the practice and process of pattern development that pattern authors follow, which we will explain next.

3. Process of pattern development and scoping reported in literature

This section offers an overview of how other authors have developed design patterns in the domain of learning design. Although there is no standardized process of pattern scoping within the pattern community, a variety of descriptions of processes have been published (for example, Mahemoff and Johnston 1999; Baggetun et al. 2004; Winters and Mor 2008). Reviewing the existing literature, attending workshops on pattern development and discussing pattern development within the learning design community allowed us to identify common stages of the pattern development process in which cultural variance and international scope is not yet explicitly observed. Figure 1 shows a schematic model of this general pattern development process including observation, analysis, articulation, refinement and implementation. In this model we synergize processes reported in recent literature and Alexander's seminal work into stages. The scope of a pattern is gradually developed from stage to stage.

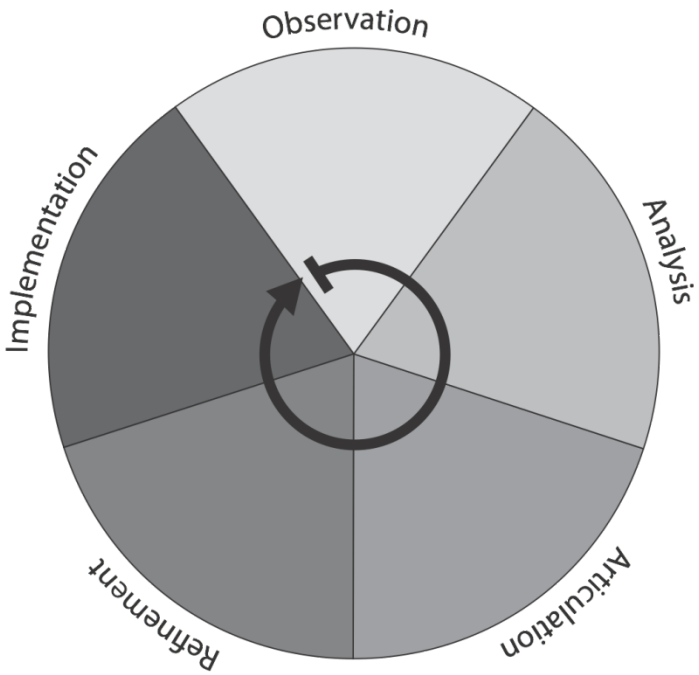

Figure 1. Pattern development and scoping in 5 stages – observation, analysis, articulation, refinement and implementation

3.1. Observation

Alexander's (1979) patterns are derived from observations of how people create their own environments, such as towns, houses, streets, etc. Learning design pattern authors use empirical observations in the form of teaching or ethnographic observations to investigate how learners use and adapt to learning environments (Brouns et al. 2005). Researchers also use other data gathering techniques such as interviews or questionnaires. Winters and Mor (2008) compile cases that describe the main observations and lessons learnt, which can be seen as pre-analysis. These cases are probably similar to what Boling (2010) termed Design Cases in the learning design domain. The scope of a potential pattern is first framed by the choice of environment in which the observations are made.

3.2. Analysis

Alexander's recurring observations formed the basis for analyzing underlying values of good solutions, which he called "quality without a name" (pp. 25). This quality was described using values, such as alive, whole, comfortable, free, exact, eternal and simple. To compose a good pattern, Alexander and his colleagues needed to understand the essential values (Alexander et al. 1977) rather than secondary or additional values that are variable and do not essentially contribute to this "quality"[4].

Every analysis is a process of abstraction leading to the identification of values. In other words, a pattern is an abstraction derived from recurring observations of examples of practice. Researchers describe inductive and deductive analysis techniques in pattern development (Baggetun et al. 2004; Winters and Mor 2009). In inductive analysis researchers

[4] Values construct the quality of lived environments or learning environments. Alexander argued that no single value can capture the quality and therefore it is termed "quality without a name". Although Alexander's values are very abstract properties, they still apply to learning environments. Scholars just use different, more domain specific words for these values, such as user friendly/easy to use (simple, alive, comfortable), support peer learning or self-directed learning (free, eternal).

look across various field studies or case studies (Winters and Mor 2008), course presentations (Brouns 2005) or learning systems (Retalis et al. 2006) to induce first concepts from the empirical data. Noticing patterns in the data leads to so-called "design pattern beginnings" (i.e., the initial content of a pattern). In the deductive process, patterns are generated based on theoretical constructs, i.e., activity theory (Guy 2005), specifications, mind maps or when pure expert judgment from experience[5] is used as a starting point (Baggetun et al. 2004). Here existing values aid the selection of examples. Winter and Mor (2009) found that typologies are a good deductive analysis method to establish a shared language among a community of pattern researchers. The choice of abstraction process is essential in defining the scope of a pattern.

3.3. Articulation

There are several formats for pattern articulation, which are indirectly built on Alexander's (Alexander et al. 1977) seminal format or Gamma's (1994) software pattern template. All patterns have common elements, such as problem description and solution statement. Usually, they are set in a specific context and supported by examples or scenarios of use in this context. Often a pattern also includes links to other patterns, explains why it works, and reports on limitations and consequences of its use. The articulation of a pattern is the culmination of the abstraction process that is started in the analysis where all essential characteristics of a pattern and the scope should be defined (Fincher 1999). Researchers of learning design pattern communities often work in international teams distributed across Europe, the Americas and Australia, and scholars are connected worldwide through pattern workshops, research consortia and Web 2.0 authoring tools. For example, Gray (2008)

[5] How scholars arrive at their judgement is arguably an inductive process, but judgment can be used as a starting point, acting like a hypothesis, to deduce a pattern from data.

reports about the use of wikis to articulate and develop patterns (Gray 2008). Others use discussion forums or other Web 2.0 resources (ELEN 2005; Goodyear 2005; Retalis 2005). Using international collaboration, it should be possible to develop a pattern with international scope at this stage. However, the community does not specify explicitly any international scope that may have been identified. A process model that highlights how international scope can be developed would be particularly helpful for those who are not closely involved in international pattern communities.

3.4. Refinement

Web 2.0 resources are also often used to share, refine and validate the pattern within a community of practice. Basically, pattern refinement makes use of the shared experiences and values of pattern experts and other members in the wider research community. An example for bringing various pattern communities together to review and refine proposed patterns is the annual conference on Pattern language of Programming (PloP or EuroPloP). The "Hillside" software development community initiates these yearly meetings for composers of patterns. The conference features a variety of design pattern workshops in computing, pedagogy or computer-supported collaborative work (CSCW). The presentation of patterns in this context presumes a rigorous three-month shepherding process to improve pattern beginnings in collaboration with a more experienced pattern author (Hillside.net 2008). At the conference, the patterns are discussed in a workshop setting by a community of practice, while the original author is only allowed to listen. Comments from the community are then used to improve the pattern's scope.

3.5. Implementation

These communities can also provide a strong foundation for linking pattern authors and potential users. For example, OLnet researchers from the UK Open University try to tackle

the problem of designing Open Educational Resources (OER) using a mix of workshops, online tools and patterns in the implementation phase. Here design patterns are used to brainstorm new learning designs within an enlarged community of practice (McAndrew & Goodyear 2007). A frequently used strategy for implementing design patterns is teaching novice designers how to use them in university courses (Chatzigeorgiou et al. 2008; Kolfschoten et al. 2008). The pattern's scope is finally tested in this stage.

A pattern's scope is developed throughout these 5 stages, but to the authors' best knowledge, only Mahemoff and Johnston (1999) offer an attempt to develop patterns with international scope in the domain of international usability. They consult cultural value dimensions (i.e., Hofstede 1997) in the analysis, articulation, refinement and implementation stages. In line with this approach, we believe that the development of international scope needs to start very early in the development process, but an obstacle for this is the variance and vagueness of the general pattern scoping process presented above.

4. A proposal for international scoping

In order to understand better and use the pattern scoping process in the light of international learning environments, we must first look at how researchers understand and design for other cultures (Lee 2003).

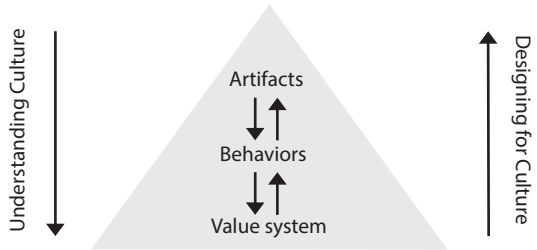

Figure 2. Understanding and designing for culture using the iceberg model of culture (adapted from French and Bell 1995; Lee 2003)

We look at culture through three different layers: artifacts, behaviors and values. French and Bell (1995), who are prominent behavioral scientists, suggested that culture is

like an iceberg. Artifacts such as commodities or fashion are above the water surface and easy to perceive. However, under the surface you have a much larger collection of behaviors and deep-down hidden values that are not so easy to perceive from the surface. Figure 2 schematizes this connection using a triangle as metaphor for an iceberg. Using the iceberg metaphor, Figure 3 illustrates a design process with an example of how a design for another culture failed. Bhabha (2005) reported that Kellogg's encountered problems when introducing their cereals in India. Cereals are formulated for cold milk. If they had done some basic market observations they would have realized that in India, culturally, people would have a hot meal in the morning. With hot milk however the Kellogg's cornflakes would go soggy. And therefore Kellogg's did not succeed in bringing their design into another culture. Figure 3 shows that in order to understand whether or not a product would succeed in another culture one has to understand behaviors and values in the target culture. Kellogg's just entered a finished product into a new market (dashed line and arrows) and the company imposed all values and behaviors associated with this product onto the new market. The "x" in this illustration shows where the process has broken down. Kellogg's advocates a convenient (fast and cheap) breakfast with cereals. In India convenience is not valued as much as health in a breakfast. Hot breakfast is considered is healthier than cold breakfast and has a long tradition in India. At this point of variance in values the localization process breaks down.

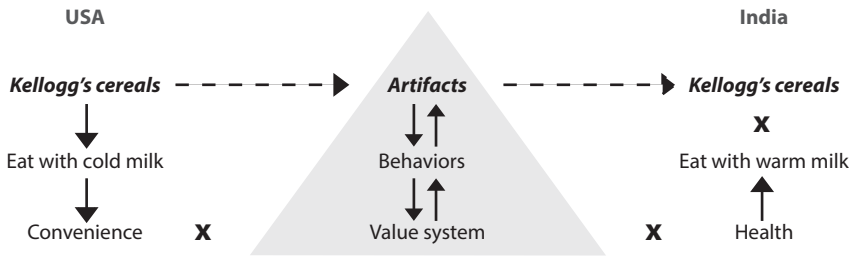

Figure 3. Example of Kellogg's failure to introduce their product into another culture (Author 1 2010)

From this example we can infer that we also need to look through three layers from artifacts down to the value system to scope design patterns for international learning

environments. In our examination we combine the pattern development process cycle that we generalized from the literature with the iceberg model of culture (Figure 4). This model shows all potential routes in understanding and designing for culture within the pattern development process.

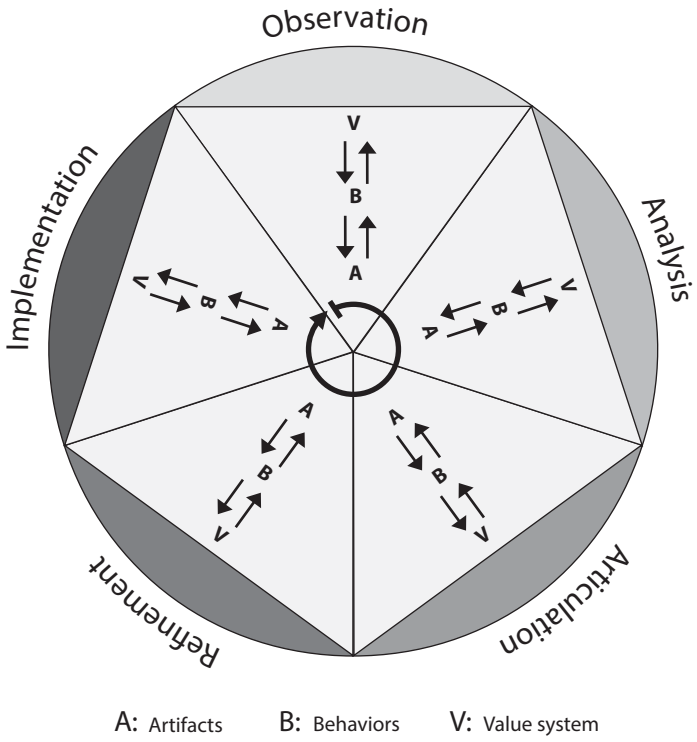

Figure 4. The Iceberg model of culture blended with the pattern development process model. The layers of Artifacts, Behaviors and Value System from the Iceberg model are applied to every stage of the pattern development process. The arrows linking artifact to values (A→ B→ V) indicate the direction of the analytic process in understanding patterns; the arrows linking values (V→ B→ A) to artifacts signify the direction of composing a pattern narrative, a synergetic process.

5. Methodology

We use a holistic case study (Yin 1994) of international collaborative learning to test the blended model of pattern development shown in Figure 4. The model has derived from a review of literature in patterns development and culture models and signifies an idealized process. The following case study gives a concrete empirical example of an international pattern scoping process. It starts with describing observations made, the analysis of

observations and the articulation into preliminary patterns. The case also reports about the refinement stage and any implementation of patterns. In each section, we scrutinize the relations between artifacts (A), behaviors (B) and values (V) as laid out in the pattern development process model (Fig 4).

5.1. Case study context and setting

The case study reports a longitudinal empirical work of internationally distributed teamwork in design learning. The primary data source for pattern development was an undergraduate university design studio subject organized by the School of Design at the Hong Kong Polytechnic University. It was taught in collaboration with partner universities and design schools in Korea, Austria, and Taiwan. Each year about 150 students worked together over a distance in mixed teams with sizes ranging from 4 to 6 persons. The goal of the design collaboration was to develop shared design concepts and solutions. Students were supported in their distance collaboration by various technologies, such as blogs, websites, forums, email file sharing and instant messaging applications.

5.2. Observation

Over three years, the researchers were able to take notes of observations and to conduct semi-structured and contextual interviews. In addition, they were able to collect the log files of the asynchronous communication on forums. They had access to a server where the teams saved their designs and shared documents and log files of the synchronous communication uploaded design sketches and design models. These observations were repeated with teams of different cultural compositions over 3 years. In addition, semi-structured interviews with eleven design experts from the professional and academic domains were conducted.

5.3. Analysis

The analysis used a mixed method approach, using qualitative content analysis (Mayring 2000) and triangulation of data sets and theories to increase rigor (Patton 2000). The data from the first and second year were analyzed inductively to identify recurring themes in design collaboration behavior using summative (summarizing observations) and latent (thematic) coding. Latent coding makes inferences of the meaning behind phrases to establish themes of codes (Tesch 1990). Interactions from Hong Kong-Korean and from Hong Kong-Austrian teams were the main data sets. Expert interviews were used to triangulate the data. In the analysis of the first year data, communication breakdowns based on dissimilar timing of project work and the sharing of design artifacts remotely could be observed in forum entries that were analyzed by summative coding. For example, a Hong Kong student posted:

"U said, ron made draft website mixing ron's rough & my rough. when will u show us? we'll finish final website design today. so now we try it. but i wonder u made rough website. and now we don't have contents about website menu."

The Korean students responded:

"... actually we don't made real site, now we don't have enough time. and our project is just planning step. not for real open site. so, we just show how is it going."

These observations were coded as breakdowns in communication based on dissimilar timing of work and the approach to designing, i.e., initial simulation versus immediate implementation of design. These breakdown categories were confirmed by expert interviews using latent coding supported by the computer-assisted analysis software package TAMS Analyzer™. For example, one interviewee stated:

"problems of sharing artifacts remotely are still so acute it is harder to provide for that kind of spontaneity",

while another interviewee said:

"... problem of pointing at stuff, like in a layout, is really difficult in text".

Both snippets were coded as "breakdowns in sharing artifacts across cultures remotely". This step would elicit several themes referring to breakdowns but also solutions to overcome breakdowns in collaboration.

In the second year network diagrams (e.g. Figure 5) were constructed from these themes in conjunction with the analysis of new data sets from Hong Kong-Korean teams. Network diagrams are visual representations of connections between the main concepts and themes from the data. The diagram method could be best described as a synergetic analysis method in which data and categories are connected to build a more coherent picture of their relation. Network diagrams help to refine categories. The synergy process is different from inductive or deductive analysis methods (see also Figure 4 description). It helps to establish relations between categories, which help forming a pattern's structured description later on in the process.

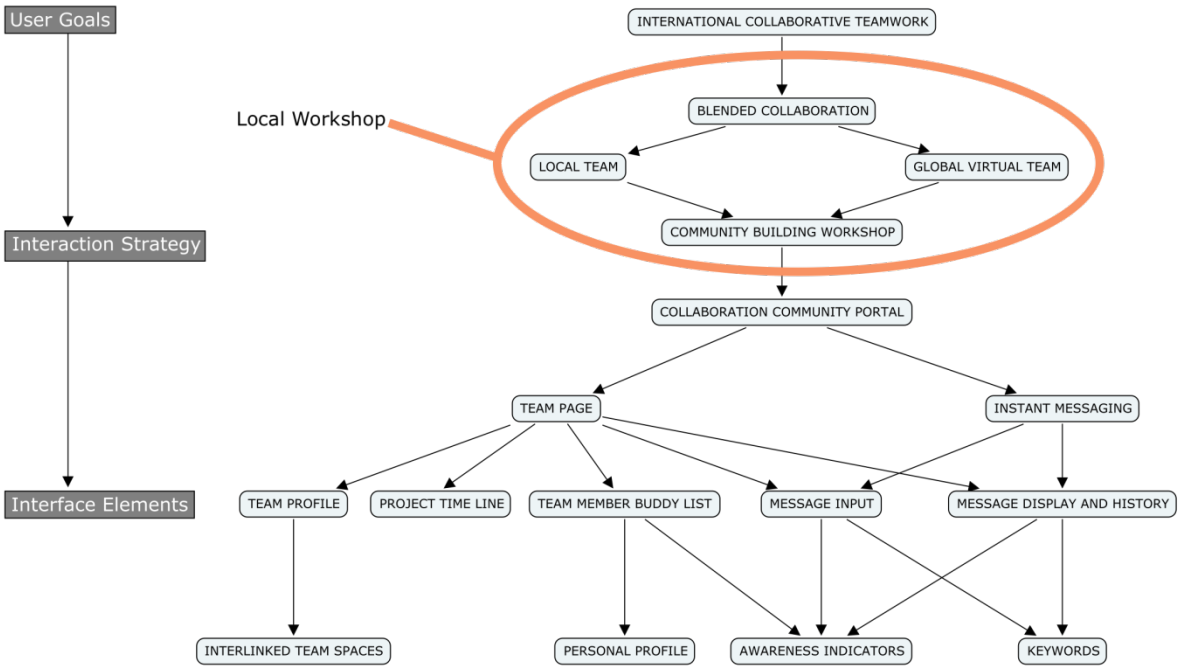

Figure 5. A network diagram links several concepts from the data which leads to the articulation of the design pattern LOCAL WORKSHOP (highlighted with an ellipse). In summary, LOCAL WORKSHOP suggests

introducing local and remote team partners in an intensive preferably face-to-face workshop. The full pattern is described in Appendix 1.

Year one and two mainly looked at recurring patterns of behavior, but it was difficult to connect these to underlying values to gain a deeper understanding of the data. The researchers' own cultural values influenced the analysis. Hence, data from the third year were analyzed deductively (theory-led) with a coding scheme informed by different theories, including collaboration support, using codes such as *Awareness* and *Communication* (Rogers et al. 2007), intercultural communication (main codes were *Breakdowns, Deal with Breakdowns, Gain Common Ground*) (Scollon and Scollon 2001) and cross-cultural communication using codes such as *Hierarchical Authority Orientation* (Hofstede 1967) or *Contextual Communication* (Hall 1990). In literature, codes and concepts that are based on established theories are called sociological codes (Tesch 1990). In this process, a codebook based on above-mentioned theories and their core constructs was established. For example, community orientation was differentiated in Collective or Individual Community value orientations. The code definition stated: "While Individual Community cultures act based on their individual needs, Collective Community cultures consider the needs of others as much or more than personal needs." Codes were applied to segments that matched the code definitions. A full list of code definitions was set out in Author (2009).

The computer-assisted analysis software package TAMS Analyzer™ and GraphViz were used to view, sort, code and analyze the data. In qualitative content analysis more than one code can be assigned to an observation (Mayring 2000). In TAMS Analyzer™, co-coding frequency is a measure of code co-occurrence with another code. A central question is how often particular codes, such as *Breakdown, Communication* and *Low Contextual Communication* appear together in the same unit of analysis. Figure 6 shows how the co-coding frequencies were tabulated and patterns of stronger and weaker relations were explored (shaded cells). Instances of high and low co-coding frequencies were traced back to

the original data, in which the recurrence of certain behaviors and their association to particular cultural value orientations was examined.

Co-coding Table	CO>Collective	CO>Individual	CC>Low	CC>High	Awareness	Communication	Coordination	Code Count
GainCommonGround	+ 437	- 181	407	334	561	274	448	746
Breakdown	- 311	+ 184	- 313	+ 318	414	+ 264	400	607
DealWithBreakdowns	+ 329	166	315	281	395	235	+ 390	576
Code Count	636	313	613	541	843	447	734	

Legend			Code Count Range
	+	Relative High	
	-	Relative Low	

Figure 6: Tabulated co-coding frequencies of intercultural communication categories (i.e., Breakdown), cultural value categories (i.e. Collective Community Orientation (CO>collective)) and collaboration categories (i.e., Awareness). Light grey cells depict low, and dark grey high code frequency. We paid particular attention to relative high (+) or low (-) co-coding frequencies of codes as these indicate a special relation between codes.

For example:

"... in the beginning we were very nervous, because our English is no so good."

The co-occurrence of the codes *Breakdown, Communication* and *High Contextual Communication (CC>High)* was relatively high in the data for this and similar statements. A lack of context, non-verbal communication and other additional clues absent in distance communication made Hong Kong students feel insecure about their English language abilities. Being aware of this communication problem, the course organizers reacted as follows:

"...Korean students come over to visit Hong Kong to work face-to-face for a few days. They will settle a topic face-to-face and later on work and finish the project remotely."

In subsequent years, this worked well to establish the design teams. A Hong Kong student commented:

"A good relationship among the team members is important. When the Koreans were in Hong Kong we talked about the project but also about personal interests. It is good and important to know the collaborator personally."

The codes *Gain Common Ground* and *Collective Community Orientation (CO>collective)* values were co-coded in this and similar observations.

This research used triangulation to increase rigor during analysis.

"The logic of triangulation is based on the premise that no single method ever adequately solves the problem of rival explanations. Because each method reveals different aspects of empirical reality, multiple methods of data collection and analysis provide more grist for the research mill." (Patton 2000, pp 1192)

Patton (2000) describes triangulation in qualitative research as ideal but expensive and often underexplored because of the researcher's narrow training. A luxurious starting point of the overarching research this study is based on was to explore different methods of pattern development in the research and development process.

This study used three kinds of triangulation to verify and validate findings from the analysis. Due to the cross-cultural nature of this research, triangulation of sources that examines the consistency of different data sources (across different cultures) was absolutely necessary. Methods triangulation was used to check consistency of findings produced by different data collection and analysis methods. Finally, theory triangulation used several theories to understand the data. Analyst triangulation, using multiple analysts to review findings, was not used in the study.

Table 1 provides an overview of the triangulation methods and validation gained in the research process. We paid particular attention to the consistency of information when triangulating sources, methods and theory to increase rigor in this research.

Table 1 Triangulation of data sources, collection and analysis and theory

Year 1					
Data sources	Data collection	Data analysis	Theory	Validation	Limitation
Hong Kong – Austria Hong Kong – Korea	- Non participant observations - Contextual interviews - Massage board entries	- Qualitative, grounded theory - Summative and thematic coding	- Inductive approach avoiding theoretical bias	- Convergence on two overarching themes: team management and technology, plus subcategories	- Problem and solution pairs mismatches - Lack of understanding of remote team perspective
International (Austria,	- Expert Interviews	- Qualitative content analysis	- Inductive approach	- Confirmation of Technology and	- Individual (not team)

Belgium, France, Germany, Hong Kong, Israel, Italy, Japan, USA, Sweden)		- Pattern and thematic coding Code frequencies	avoiding theoretical bias	team management themes - Convergence on subcategories: Breakdowns, understanding, awareness, communication, coordination, tools	perspective - No problem and solution pairs
Year 2					
Data sources	Data collection	Data analysis	Theory	Validation	Limitation
Hong Kong – Korea	- Non-participant observation - Contextual interviews - Email, blog entries chat transcripts, documents	- Qualitative, grounded theory - Summative, pattern and thematic coding - Network diagrams	- Inductive approach avoiding theoretical bias - Network diagrams synergize Interaction design theory (Welie & Veer 2003) and emerging patterns	- Confirmation of Technology and team management themes Emerging patterns under previously identified subcategories - Convergence on some matching problem - solution pairs	- Patterns with mixed intent (management / technology) - Some problem – solution mismatches - Which pattern for which culture? - Limited data source
Year 3					
Data sources	Data collection	Data analysis	Theory	Validation	Limitation
Hong Kong – Austria Hong Kong – Korea (+ 2nd set from year before) Hong Kong – Taiwan	- Non-participant observation - Contextual interviews - Emails, blog entries, chat transcripts, documents	- Qualitative content analysis - Pattern and summative, thematic coding - Sociological coding (theoretical constructs) - Code frequencies - Co-coding frequencies	- Deduct coding scheme from intercultural communication theory (e.g. Scollon and Scollon 2001) and cross-cultural communication theory (e.g. Hofstede 1967)	- Equally important main themes - Problem (Breakdown) Solution (Deal with Breakdown) - Collaboration support (e.g. Coordination) - Culture value dimension (e.g. collective or individual community) - Test co-occurrence of themes (e.g. cultural values) - Increased confidence in Problem – Solution pairs	- Some patterns have limited scope

Over the years we have reached consistency in overall patterns of data from different sources and with different collection and analysis methods. The most important validation check was theory triangulation in the 3rd year. It not only allowed us to understand how

different theoretical assumptions affected the findings, but also helped to achieve consistency in the pattern articulation.

5.4. Articulation

In the third year and after the deductive analysis, the learning design pattern *Grand Opening* (Appendix 2)[6] was articulated based on the data analysis explained in the previous section. The pattern proposes an initial face-to-face meeting to allow participants to get to know each other, to build a community of learners and to start off the distance design project collectively. In triangulating with other datasets, this pattern could be observed in Hong Kong/Korean and Hong Kong/Taiwanese learning teams, but not in Hong Kong/Austrian collaboration. The data showed a clash in value systems that supported this behavior. For example, a Hong Kong student said about working with Austrian students:

> *"I think the working process between Hong Kong and oversee student is really different. [] … we don't understand them, [] … we tried to be friend with them and tried to chat with them very frequently, but at the end, because we are busing with the project and they have their things to do, the connection was a bit dethatched.*

While another Hong Kong student who worked with Korea said:

> *"We go sightseeing, afterwards we discussed the collected ideas, and defined a common goal."*

Austrian cultural values show much more individualistic tendencies than in Hong Kong, Korea or Taiwan. This tendency decreases the significance for establishing collective values in the design team for Austria. Figure 6 shows a high co-occurrence of the codes *Breakdown* and *Individualistic Community Orientation* (*CO>Individual)* (non-shaded cell with a plus sign "+"). Hong Kong/Korean or Hong Kong/Taiwan teams showed a stronger

[6] The appendices are provided in form of a link to a blog at the end of the paper.

collective community orientation and hence valued the creation of a larger learning community over a distance. Figure 6 shows a high co-occurrence of the codes *Gain Common Ground* and *Collective Community Orientation (CO>Collective)*. The limitation in scope was articulated in the pattern.

We illustrate the articulation of the pattern *Grand Opening*. The context and problem sections state a mismatch (or similarity) in culture-specific online behavior. In *Grand Opening* it reads: "*They are excited about this opportunity, but they are also nervous about how they will perform as they want to keep a good relationship with their collaborators*". The forces explain the value dimensions that were in conflict leading to this mismatch (or similarity), i.e., students from both Hong Kong and Korean cultures have a Collective Community Orientation. A part of the forces section states: "*Although all participants know the project brief, it is difficult for the distributed groups to approach the design problem because they are unaware of each other's personal and professional backgrounds, culture, expectations and goals. ... Collaborators with a Collectivist Community Orientation, such as Hong Kong and Korean students, need to develop a sense of belonging to the learning community and remote team members in order to trust each other and take responsibility for the project outcome*." The solution section links designed artifacts and systems to recurrent behaviors i.e., the team establishes friendship and a common goal in a local workshop. The solution section reads: "*A memorable beginning of the design project helps students to connect emotionally to the community and team. For this purpose, interweave off and on task activities in the collocated short workshop*". A section on consequences explains why the solution worked (i.e., through shared values) and how the forces were resolved in a good way. An excerpt from this section is: "*In an intensive and inclusive workshop where formal and informal meetings are intertwined, collective community cultures establish a friendly relationship, which is important fuel to a successful collaboration beyond this workshop*".

11 patterns were fully written and 7 were partly articulated. An overview of the pattern collection is given in Author (2009). In the comparison of datasets, only 3 patterns showed international scope, for example *Annotated Design Gallery* (Appendix 3). An annotated design gallery supports sharing and interpreting of locally implemented design variations. All other patterns confined their limited scope to the cultures where the solutions were observed to work well.

5.5. Refinement

The pattern *Grand Opening* was refined from an earlier pattern called *Local Workshop* (detailed in Appendix 1). The ellipse in Figure 5 shows the themes of analysis that led to the pattern identification in the Analysis stage. A short intermediate evaluation process of *Local Workshop* with novice and more experienced designers disclosed some limitations of the format used to articulate the initial learning design pattern. The evaluation took the form of focus group discussions in which the pattern format and usefulness of content were central themes in the discussion. The pattern evaluators pointed out that there should be a more detailed investigation into which cultures the proposed solutions might be valid. Deductive analysis of a further data set (data triangulation) using theories of intercultural communication and others (theory triangulation) was used to evaluate and refine the emerging patterns. The rewritten pattern was renamed *Grand Opening*. This and other patterns were further refined in a longer shepherding process organized by the Hillside Design Patterns community (Author 2007) and experts in cross-cultural collaboration (CHI 07 workshop participants (Fussell and Zhang 2007)) who reviewed and discussed the patterns' composition, content and scope in focus group discussions.

The discussions with experts help to assess the balance between abstraction and specification in a pattern which is a bidirectional analytic and synergetic process often leading to a new articulation of the pattern or the addition of examples or references. After

this evaluation, the pattern format of *Grand Opening* changed slightly, the limited scope was described and visualizations were added.

5.6. Implementation

To the authors' best knowledge, the pattern *Grand Opening* has not been implemented internationally as it proved a limited international scope. However, some other patterns with international scope were implemented through their dissemination in a small circle of colleagues. For example, the pattern *Annotated Design Gallery* inspired discussions of functionality of new software used in a distance design-learning module at a large UK distance University. The pattern *Annotated Design Gallery* suggests that the textual annotation of highly ambiguous visual representations reduces ambiguity in interpretation of a representation across cultures. This pattern was previously identified to have international scope, because it was observed in Hong Kong/Korean, Hong Kong/Taiwan and Hong Kong/Austrian design learning environments alike. This wider applicability was confirmed in this new collaborative distance design learning setting within a different cultural context.

6. Findings

The above case tested our initial idealized blended pattern development process model (Figure 4) against the reality of pattern development in an international setting. Figure 7 answers the main research question of this study "How can we develop design patterns with international scope?" and introduces a framework for developing learning design patterns with international scope.

Our case suggests that scoping of design patterns for international learning environments starts with observing behaviors (B) afforded by technological artifacts (A) in several comparable cross-cultural or international learning environments (A→B). In our

particular case, students' communication behavior (B) could be observed through the use of learning software (artifacts (A)); schematically, it is represented as A→B.

Recurrently observed behaviors (B) are grouped into more abstract categories and themes in the analysis stage. Inductive analysis informs the first themes and synergetic analysis establishes links between themes. Deductive analysis refines the grouping of themes and most importantly strengthens and establishes links to underlying core values (V) (B→V). These core values are aligned with theories of intercultural communication and cultural value dimensions. In our case, we employed an inductive approach to data analysis to identify categories of behavior first. In the deductive, theory-led coding, values were associated to these behaviors. Intercultural and cross-cultural communication theory (i.e., Hofstede 1986; 1997) facilitated the identification of sociological codes for a deductive analysis, and the use of computer supported analysis software (particularly coding frequencies) aided in the identification of shared values in international collaboration.

In the articulation stage, we work our way up again starting from the shared values (V) that are highly related to themes of recurrent behaviors (B) (V→B). We compare behaviors across data sets (cross-cultural collaboration contexts) and identify possible international design patterns (recurring behaviors we have seen in all data sets). If we can detect themes that are linked to the same cultural dimensions (identified in sociological coding) then we have an indication of a pattern with international scope. The observed behaviors are used to illustrate and articulate the pattern sections such as *problem, forces* and *solution.* The articulation is supported by identifying several examples of learning behaviors that were supported by artifacts and their functionality in different cultural settings. These examples are also articulated in the pattern. Core values are often incorporated in a pattern in the *context, forces* and *consequence* sections but also in the section *theoretical justification* when it is present in the pattern template. Linking core values to recurrent behaviors and artifacts that

support these behaviors is a very essential activity in the pattern development and scoping cycle (V→B→A). In our case, we exemplified how in the pattern GRAND OPENING mismatching cultural values induce forces in conflict on collaboration behaviors, which cannot be resolved in some cross-cultural settings. For this reason the pattern expressed a limited scope.

In the refinement stage, a group of international reviewers scrutinize *Grand Opening* and other patterns based on their shared experience in their field (Author 2007). The international review helps to refine the articulation of the pattern and its international scope (V←→B←→A).

In the implementation stage, potential users (learning designers) can understand whether or not a pattern would fit their cultural context by comparing the core values, behaviors and artifacts described in the pattern with the goals and learning outcomes in the target learning environment (V→B→A). In our case, in the discussion of the learning outcomes (including values (V)), the learning design team found that students needed to learn to clearly communicate ideas so that others can understand these ideas and hence critically discuss them (behavior (B)). This behavior is supported by learning design software (artifact (A)) in which students can annotate visuals and comment on uploaded photos of other students' work.

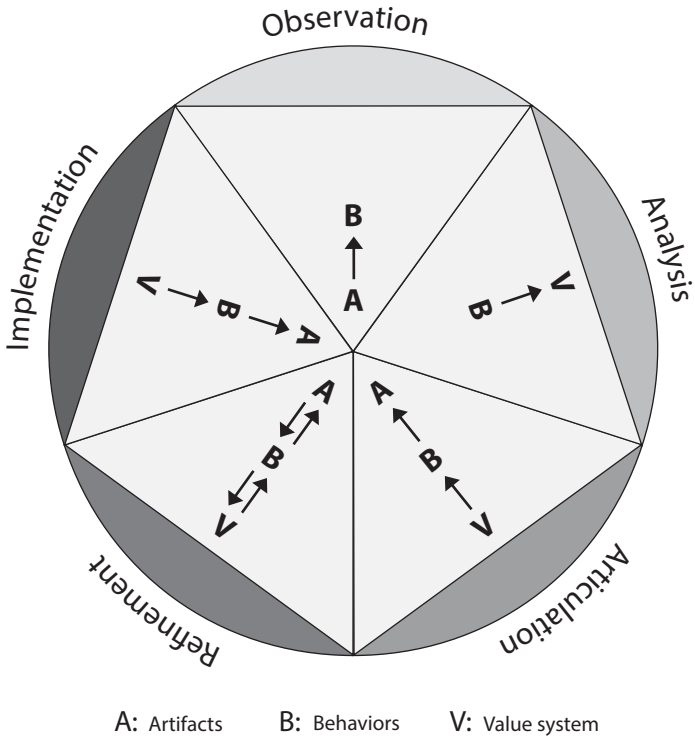

Figure 7. A process model for developing international scope of learning design patterns

7. Discussion

We believe that the discussion of culture is particularly relevant to design patterns. A design pattern is a generalization of observations. It is in the nature of a pattern to abstract the solution to allow multiple potential applications in many cultural contexts. Winters and Mor (2009) emphasized that "*generalisation was supported through the identification of salient features across comparable cases.*" (pp.1083). We demonstrated in our framework how exactly these salient features[7] can be identified and articulated. In order to understand a pattern we suggest following the direction of arrows starting from the artifact leading to behavior and values (A→B→V) and to compose a pattern values are linked to behavior and artifacts (V→B→A). This link is indicated by the direction of the arrows in Figure 7. In each phase of pattern development, different combinations of A, B and V (i.e., subsets) are

[7] Salient features are underlying values, linking to behaviours and artefacts that define the quality without a name.

anticipated. Alexander's (1964) thoughts in "Notes on Synthesis of Form" support the argument of a cyclic pattern development process:

> *A culture does not move from one change to the next in discrete steps, of course. New threads are being woven all the time, making changes continuous and smooth. But from the point of view of its effect on a form, change only becomes significant at the moment when a failure or misfit reaches critical importance – at that moment when it is recognized, and people feel the form has something wrong with it. It is therefore legitimate, for our purpose, to consider a culture as changing in discrete steps. (p.44)*

In Alexander's (1979) opinion there is a particular set of patterns for every culture. He observed that farmers do not copy another barn in every detail, but they have a more abstract conception of a barn that is guided by functionality. A barn may vary not only with geography and weather conditions but also with social factors such as farm, family or community size. If a farmer from another region wants to build a barn they would use the same principle, a barn with different details would arise. In order to build a design in one culture from a pattern that originated in another, the designer needs to interpret and adjust the principle to the local context. However, learning designers need to design for other cultures than their own, and often designs are used by multiple cultures, such as in international collaborative learning. The learning designer will find it difficult to adjust a design principle to another culture without understanding the consequences. If the designer is applying the design principle only with his or her own cultural values in mind, the design is likely to fail, because the design is culturally biased. For example, in our case study, some students/teams failed to collaborate entirely because some learning activities and technologies did not promote communication and awareness building across cultures (i.e., *Grand Opening* did not work internationally). Learning designs with international scope would have facilitated variations in communication styles (i.e., using *Annotated Design Gallery*) and created

awareness of cultural variations. Hence, patterns need to indicate their known scope or international scope for designers to develop appropriate learning designs for other cultures.

8. Limitations

The researchers are aware that when employing a deductive coding scheme one has to balance a particular focus in data interpretation with increased rigor in data coding. Sociological codes support the analysis of data in a much more rigorous way and limit the cultural bias of the researchers during coding. However, it does give a particular focus on one theoretical area rather than another, in our case national culture rather than institutional or professional culture. For example, if the coding scheme had included a focus on institutional cultures, the pattern *Grand Opening* potentially would have shown to have a limited scope but for other reasons. The institutions in Austria and Hong Kong weighted the factor of successful collaboration differently. For Austrian students it was an elective course, while for Hong Kong students it was a compulsory course. The lack of collaboration could have been assigned to this difference instead of differing Community orientations. However, the Korean institution also weighted collaboration differently. Korean students had already started the module in advance and where in a different stage of designing. Collaboration could have failed in the same way as it did with Austrian students. But we saw much more commitment to the teams' shared outcome in Hong Kong Korean collaboration than in Hong Kong Austrian collaboration, indicating that the shared value of Collective community was a valid interpretation in this case. Ideally a deductive coding scheme would investigate multiple layers of culture, which is a limitation in this research.

9. Conclusions

This paper examined the problem of pattern scoping for international learning environments. We propose a specific process model that particularly highlights the

methodological foundations of scoping patterns. This process of abstraction ties the observation of learning behaviors through technological artifacts in different cultural settings to the analysis of core values. Patterns in the data are used to articulate first design patterns by linking the values back to recurrent behaviors supported by technological artifacts in different cultures. These core values are also used as a guide to refine the patterns in communities of practice. The up- and down-movement through these layers of culture helps identify and articulate core values and culture-independent features that constitute the international scope of a learning design pattern. An indication of the scope of a pattern, either international or limited to some cultures, improves not only the pattern development but also potential pattern use.

Following this framework gives flexibility in pattern scoping and articulation. We do not intend to prescribe a fixed pattern structure but rather want to open up a discussion on how international scope can be incorporated in a variety of pattern templates that exist in literature and practice. International scope could be incorporated into the core sections, or a pattern could contain additional sections that articulate its scope. In our research, we have used context, forces and consequence sections to indicate the international or limited scope of a pattern. Descriptions of different international examples in which the pattern works also illustrate the international scope of the pattern. We believe that pattern researchers will be able to find multiple strategies to express the scope of a pattern following our process model without being too limited in their chosen pattern format. Patterns specifying their international scope in these ways can support learning designers to understand deeper principles behind learning designs and open up the possibility to transfer the solution to different cultural contexts.

In future work we intend to validate the integrated model by applying it to other cross-cultural computer-supported learning settings.

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Appendices (1, 2, 3)

See: http://patternscoping.blogspot.com/